

Improving the EWA Implementation Process: Science Program and EWA Agencies' Progress in Water Years 2005 and 2006

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The EWA Technical Review Panel (Panel) prepared a report for the Lead Scientist in January 2005 following the November 2004 EWA Workshop. In that report the Panel recommended that the EWA agencies needed to expand the research base and upgrade the quality of science underlying EWA program decisions. In the Lead Scientist and EWA agencies joint response to the Panel we outlined a framework to address the important issues identified by the Panel, with the overall goal of increasing the efficacy of the EWA. In this report we address the progress that has been made on each of these issues in 2005 and 2006.

- I. Use and Interpretation of Gaming:** The Panel identified the water operations gaming as a powerful modeling tool, as long as the process is transparent and rigorous. It recommended incorporating more biological information and treating uncertainty explicitly.
Action: Document gaming objectives clearly. Set up technical panel of outside experts on modeling, gaming, ecosystem dynamics, risk assessment, and fish biology. Team this panel with appropriate agency scientists/managers familiar with EWA and the broader water operations system.
Goal: Expand gaming to include a more rigorous biological basis, and uncertainty/probability distributions in decisions for any future long-term EWA.
Commitments: CALFED Science Program: Establish and fund technical experts. EWA agencies: Supply staff participation, organization, and logistics.
Progress: EWA Agencies did not pursue gaming in 2005 or 2006.

- II. Interpretation and Use of Models**
 - A. Fish Population Models:** Panel was concerned that there was insufficient, and in some cases, inappropriate use of models to design and size EWA. Despite previous Panel recommendations, the hydrodynamics and Particle Tracking Model (PTM) were not used in planning or real-time operations. The biological models that were used were overly simplistic and lacked biological basis.

Action: The CALFED Science Program PSP called for research supporting development of specific models, including those related to delta smelt and salmon. EWA agencies will continue developing the Delta Smelt Decision Matrix (DSRAM) and supporting the IEP and other researchers attempting to develop population estimates and models for delta smelt and encourage their submission for peer review and external assessment.

Goal: Establish accepted, peer-reviewed model(s) that can be used by the EWA Agencies to model population-level effects of water operations.

Commitments: CALFED Science Program: Fund CALFED Science Programs PSP proposals as approved by the Authority and facilitate workshops on delta smelt models, with emphasis on developing the framework for ecosystem-level models encompassing population effects. EWA agencies: Supply staff participation in workshops and incorporate modeling into decision making. The Science Program and agencies will develop a protocol for improving the efficiency and use of the PTM.

Progress:

1) In the 2005 round of funding the Authority approved two Science Program PSP proposals, one to model the delta smelt population (proposal #106) and one to model salmon in the Central Valley (proposal #214). Both projects are now under contract with work in progress. The executive summaries for the projects, and all proposals noted below, are available at

http://www.science.calwater.ca.gov/psp/psp_package.shtml.

2) In 2005, the CALFED Science Fellows Program funded one model on Central Valley salmon. The abstract for this model, and all other funded projects, is available at

<http://www.csgc.ucsd.edu/EDUCATION/CALFED/CALFEDClass05.html>.

3) In November 2005 the Science Program sponsored a Pelagic Organism Decline (POD) Technical Panel Review which addressed the IEP delta smelt workplan and sponsored a workshop in December 2005 to present the findings from the review. All the materials from the review and the workshop, including the Review Panel Report and the response to the Panel Report are available at http://www.science.calwater.ca.gov/workshop/workshop_pod.shtml.

4) The Delta Smelt Working Group (DSWG) applied PTM more systematically and used the results to make recommendations to the EWA agencies on the use of EWA assets to protect larval and post-larval delta smelt. Appendix 1 summarizes the application of the PTM in 2005 and 2006 including the technical basis for recommendations and a preliminary proposal for improving the use of PTM by EWA biologists.

5) In June 2006, the CALFED Science Program released a Focused Proposal Solicitation Package (PSP). The PSP focused on four primary topic areas: Aquatic Invasive Species, Trends and Patterns of Populations and System Responses to a Changing Environment, Habitat Availability and Response to Change, and Environmental Water. Eight proposals were received for the topic of Environmental Water and two proposals addressed delta smelt modeling. Summaries of these proposals, and other proposals noted below, are available at http://www.science.calwater.ca.gov/psp/psp_package_2006.shtml. These proposals are now undergoing technical review. Awards are expected in December 2006.

6) In 2006, the CALFED Science Program also requested applications for the collaborative CALFED Science Fellows Program that address either the four topics outlined in the 2006 PSP or management/Agency identified research needs focused on EWA, Drinking Water Quality, or POD. Fellowships were announced in October 2006. Three of the eight funded projects focus on development of models to increase our understanding of factors affecting salmonids and Delta smelt survival. Appendix 4 contains a list of the funded projects. A summary of each project will be posted on the CALFED Science Fellows Program website in December 2006. General information about the CALFED Science Fellows Program is available at: <http://www.csgc.ucsd.edu/EDUCATION/CALFED/CALFEDIndx.html>

B. Climate Change Scenarios

Actions: Coordinate with ongoing modeling by DWR and USGS to establish potential future scenarios for water operations, flow, temperature, salinity, and other factors. Actions will require a combination of review, workshops, technical panels, and directed research.

Goal: Facilitate move from using historical hydrographs for planning future water management strategies to using probability distributions of future flows based on climate and watershed model projections.

Commitments: CALFED Science Program: Help coordinate efforts to identify implications for project operations and EWA with other agencies. EWA agencies: Staff participation in reviews, workshops, and research, and incorporate outcomes into long-term EWA acquisition and management decision processes.

Progress:

1) The Authority approved funding for CASCaDE: Computational Assessment of Scenarios of Change for the Delta Ecosystem which incorporates various models to predict the effects of climate change on the Delta (proposal #84).

2) In June 2005 USGS and USFWS sponsored a workshop on the Future Challenges Project which addressed global climate change and water resource management. Information about the workshop can be found at www.usgs.gov/future_challenges/doc/summaries.doc.

3) Three proposals submitted in the 2006 Focused PSP addressed the possible effects of climate change. These proposals are now undergoing technical review. Awards are expected in December 2006.

4) In 2006 the CALFED Science Fellows Program funded one proposal on the impact of global climate change on delta fishes (Appendix 4).

C. Juvenile Salmonid Mortality Estimates

Actions: Increase monitoring of juvenile fish to develop better estimates of mortality throughout the system. There are additional needs for population models. This will require evaluation of the use, or expanded use, of a variety of monitoring techniques, potentially including bioacoustic tracking, Passive Integrated Transponder (PIT) tagging, coded wire tagging, rotary screw trapping, beach seining, and trawling. Establish an expert panel and hold workshops on salmonid monitoring technology to inform a request for directed research proposals. Expansion of salmonid monitoring and research through IEP Plus Project Work Team (CMARP III).

Goal: Establish an improved juvenile salmonid monitoring system on the main-stem Rivers and the Delta to provide calibration data for salmonid models used to identify population-level effects of EWA fish actions.

Commitments: CALFED Science Program: Establish an expert panel, coordinate workshops on monitoring techniques, and coordinate a fund request for proposals. EWA Agencies: Supply staff to participate in workshops and evaluate techniques.

Progress:

1) In 2005 the Authority approved two Science Program PSP proposals that address this issue. They include the survival and migratory patterns of juvenile salmonids using bioacoustic tagging (proposal #313), and a review of four coded-wire tag experiments (proposal #299). Both projects are under contract and work is in progress. The project descriptions are available at: https://solicitation.calwater.ca.gov/solicitations/2004.01/reports/selection_panel_04_static.

2) In 2005 the CALFED Science Fellows Program funded one project related to Central Valley steelhead survival. The project description is available at:

<http://www.csgc.ucsd.edu/EDUCATION/CALFED/CALFEDClass05.html>.

3) Three proposals were submitted in response to the 2006 Focused PSP that address juvenile Chinook survival and abundance. These proposals are now undergoing technical review. Awards are expected in December 2006. Summaries of all of the proposals received are available at

http://www.science.calwater.ca.gov/psp/psp_package_2006.shtml.

4) In 2006, two Fellows projects were funded through the CALFED Science Fellows Program—1) estimating juvenile salmonid survival and distribution through the Delta and 2) genetic marker methodology validation for use for salmonid population assessment (Appendix 4).

5) In 2005 the CALFED Science Program held a seminar on PIT tagging, and workshops on Delta Action 8, salmonid monitoring, and predation at the Delta Fish Facilities. Appendix 2 summarizes the purpose of each workshop, their relationship to EWA, and provides links to the background material. For additional information on the workshops see:

<http://science.calwater.ca.gov/workshop/ewa.shtml>

6) Three new Chinook salmon and steelhead monitoring programs have been funded by the CALFED Ecosystem Restoration Program with implementation expected in 2006. These programs include a Central Valley Constant Fraction Marking program for fall run salmon, Central Valley Chinook Escapement and Steelhead Monitoring Plans, and the Central Valley Chinook Salmon Age Determination Program. Appendix 3 contains a brief summary of each program.

7) In December 2006 and January 2007 USFWS will release Coleman Hatchery late-fall Chinook with ultrasonic tags along with the coded-wire tagged Chinook as part of the Delta Action 8 experiment to evaluate survival in the Delta. USFWS is coordinating with the researchers conducting the juvenile salmonids survival study that starts in January 2007 (This project funded through the 2004 Science PSP-- proposal #313).

8) DWR is funding work on steelhead predation in Clifton Court Forebay using ultrasonic tags (B. Fujimura, DFG-Bay Delta Division, personal communication).

9) DWR funded pilot work using ultrasonic tags to assess movement of juvenile salmon in and around Franks Tract (Dave Vogel, personal communication).

10) DWR is also conducting a growth and migratory study of juvenile steelhead on the Feather River using PIT tags (Jason Kindopp, personal communication). Results from these studies may provide beneficial information for EWA biologists on salmonid life-history strategies.

11) In August 2005 DFG completed a general summary of existing Chinook salmon and steelhead monitoring programs. The document is available at http://www.dfg.ca.gov/nafwb/pubs/2005/CV_MonitoringPrograms.pdf and contains program objectives, monitoring methods, variables measured, data management and storage, reporting, staff levels, funding and contact information. This document is currently being updated.

12) In March 2005 NOAA Fisheries published a more comprehensive technical memorandum entitled *Summary of Monitoring Activities for ESA-listed Salmonids in California's Central Valley* which is a compilation of data on winter- and spring-run Chinook and steelhead for use in their technical recovery planning.

13) In 2006 EWA biologists revised the DCC gate operation section of the Chinook salmon decision tree based on updated analysis of gate closures and subsequent loss at the Delta Fish Facilities.

D. Peer Review of Models

Actions: Conduct peer review of all models, decision trees, gaming etc. Modeling should be scoped and constructed to answer specific questions and incorporate and describe uncertainty. Models will be subject to external peer review. Approaching the California Water Forum for advice or assistance is an option; another is funding post doctorates to work with agency scientist to prepare models and decision trees for publication in the peer-reviewed literature, to ensure acceptance by both agencies and stakeholders.

Goal: Have all models that are used for management decision making be peer reviewed and available to the public.

Commitments: CALFED Science Program: Facilitate peer review of models. EWA agencies: Supply staff to participate in review process and incorporate outcomes into management decision making.

Progress:

1) In 2005, the Science Program sponsored a science review of the San Joaquin River CALSIM II model. Supporting documents from this review are available at http://www.science.calwater.ca.gov/workshop/calsim_docs_05.shtml.

2) In November 2005, the CWEMF and CALFED Science Program cosponsored a workshop to review other San Joaquin Valley Modeling which included a salmon population model developed by Dean Marston (DFG). Supporting documents from this workshop are available at <http://www.cwemf.org/workshops/SJRModelingWrkshpAgenda.pdf>.

3) In addition, several models were approved for funding through the 2004 PSP process. We will follow their progress and participate in the reviews once the models are complete.

4) EWA biologists reviewed many of the available Chinook models in the last two years.

E. New Research

Actions: Expand directed research on biological questions related to EWA and increase collaboration between agency scientists and academic scientists to work on these questions. EWA agencies will work collaboratively with the Science Program and its grantees in the development of a body of work that further supports the technical basis for resource decisions. The IEP POD PWT will continue investigating reasons for the decline of pelagic organisms in the estuary, including a possible linkage to increased Delta exports.

Goal: Incorporate more results from directed research into EWA decision process. This will require better and more detailed analysis of existing data sets driven by models and hypotheses. Improve access to and expertise with the PTM and expedite distribution of results.

Commitments: The CALFED Science Program will fund approximately \$6-\$10 million of new research starting in 2006. Much of that work is related to the water operations and fish populations as approved at the August 2005 Authority meeting. EWA Agencies: Supply staff to participate in the POD PWT.

Progress:

1) In 2005 the Authority approved 13 PSP proposals for approximately \$10.7 million and the contracts have been executed. A full list of these proposals is available at http://science.calwater.ca.gov/pdf/psp/PSP-Final_Selection_Panel_Results-public_070105.pdf. Information from all 13 proposals will help improve our understanding of the estuary and its watershed and thus improve the science underlying EWA management. Three proposals not mentioned previously that could provide substantial information include foodweb support in the estuary (#107), life history variation in Steelhead (#140), and the identification of geochemical markers to determine Delta use by Chinook salmon (#179).

2) In September 2005 the delta smelt white paper, *Critical assessment of the delta smelt population in the San Francisco Estuary*, was published in the San Francisco Estuary and Watershed Science on-line journal. The paper outlines the critical data gaps which need to be addressed in order to develop the necessary tools for management and restoration. The paper is available at <http://repositories.cdlib.org/jmie/sfews/vol13/iss2/art1/>.

3) The salmonid white paper is currently in press with the San Francisco Estuary and Watershed Science on-line journal and should be available by the end of 2006.

4) In June 2006 the Authority approved the release of the Focused PSP which received eight proposals that could provide valuable information to help improve EWA management. Awards are expected in December 2006. Summaries of all of the proposals received are available at

http://www.science.calwater.ca.gov/psp/psp_package_2006.shtml.

5) Also in 2006 the CALFED Science Fellows Program requested applications that address either the four topics outlined in the 2006 PSP or focus on Agency needs (EWA, Drinking Water Quality, or POD). Many of the funded Fellow projects address key questions relevant to EWA management, such as salmonid migration and survival through the Delta, increased understanding of mechanisms affecting Delta smelt populations decline, including food web linkages. Appendix 4 contains a list of all the funded projects. Project summaries will be available on the CALFED Science Fellows Program website

(<http://www.csgc.ucsd.edu/EDUCATION/CALFED/CALFEDIndx.html>) in December 2006.

III. Improving the Review Process: The Panel recommended some changes to EWA review process to strengthen and improve future reviews with a new panel.

A. Include Broader Audience and Better Dialog with the Panel

Actions: The Science Program will establish a new review Panel and request assistance from the new Panel members in the development of the agenda/charge/organization of the review.

Continue posting meeting notices, meeting summaries, and technical material on the CALFED website in a timely manner. Provide more opportunity for non-agency scientists to present data/models/interpretations to the Panel and to be included in the primary record of the review process. More interaction is needed among the Panel, Lead Scientist, Science Program, and EWA agencies' staff during development of the review.

Goal: Get a broader perspective on the outcome of EWA decision-making and science needs, and allow the Panel to use its expertise to drive the review process.

Commitments: CALFED Science Program: Facilitate communication among the Panel, CALFED Science Program, and EWA agencies. EWA agencies: Increase level of staff participation and communication with Science Program and Panel.

Progress: The new Panel was assembled in September 2006 and the Science Program and EWA agencies worked with the new Panel in preparation for the 2006 EWA Review.

B. Formalize the Response to the Panel

Actions: The CALFED Science Program will formalize the response and make it a permanent part of the review process. The Science Program will foster a joint response by the Lead Scientist and EWA agencies. The response will provide information regarding the capacity of EWA agencies and Science Program to respond to the Panel's review, clarify any information the Panel may have misunderstood, and identify topics on which EWA agencies/Science Program and the Panel disagree.

Goal: Establish a mechanism for provision of a joint response within 3 to 6 months of the issuance of the EWA review.

Commitments: CALFED Science Program: Dedicate staff. EWA agencies: Dedicate staff; provide presentations to the Panel and Authority, including response to the Panel recommendations.

Progress: In 2004 the Lead Scientist and EWA agencies prepared a joint response to the Panel's review and will continue to do so in future years.

C. Revised Review Process

Actions: Change the review period from annual to biennial to allow more progress on key science issues between reviews and better preparation for the review. Use a smaller Panel and incorporate stakeholders into the biennial review process. Change balance of expertise among Panel members to include more biological/ecological and engineering scientists and fewer social scientists. In the off years, certain Panel members may be invited to participate in EWA-related workshops and become more involved in other EWA activities to keep them informed of key issues and results.

Goal: Make the review process more responsive to broader issues rather than reporting incremental changes in information.

Commitments: CALFED Science Program: Facilitate incorporating broader EWA issue, focus key science issues, fund workshops and Panel members to participate in EWA activities or workshops. EWA agencies: Participate in reviews and develop substantive material for review.

Progress:

1) The Science Program changed the review period to biennial starting in 2005, with review scheduled for 2006 and established a new Panel with expertise consistent joint response commitment (smaller panel, more biological/ecological expertise, now only one social scientist).

2) In 2005, the first off-year, a workshop was held in December and included several Panel members and non-agency scientists. In 2005 one Panel member also participated in the Science Program Predation workshop.

3) The EWA agencies continued preparing material, especially on delta smelt, for the 2006 review.

D. Role of Science Advisors

Actions: Clarify the role of the Science Advisors and their interaction with Panel and the EWA agencies. This will require a change in the charge to the Science Advisors and possible a change in Advisors that will be developed by the Lead Scientist to address important unknowns in the science related to EWA management.

Goal: Define the detailed role and level at which the Science Advisors will offer independent evaluation and analysis of data associated with EWA fish actions or science needs for the CALFED Science Program.

Commitments: CALFED Science Program: Provide staff and clarify role of Science Advisors. EWA agencies: Provide staff and input into the role of Science Advisors.

Progress: In February 2005 the Science Advisors prepared a draft charge for consideration by the Lead Scientist. Appendix 5 summarizes the charge and addresses the Science Advisors primary role, activities, and responsibilities. Currently roles and identities of advisors in the EWA Program as still under consideration, pending appointment of new Lead Scientist in January 2007.

Appendix 1

Application of Particle Tracking Modeling to Environmental Water Account Decision-Making¹

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Introduction

In its 2004 written review comments, the Environmental Water Account (EWA) Technical Review Panel recommended that Particle Tracking Modeling (PTM) be applied to EWA decision-making. Although PTM has been used sporadically in the past, the Delta Smelt Working Group applied PTM more systematically during water year 2005 than in previous years to assist with the formulation of recommendations intended to protect larval and post-larval delta smelt in the south Delta from entrainment at the State and Federal water export facilities. This paper will provide a summary of the application of PTM in water years 2005 and 2006, the technical basis for the recommendations that were made, and a preliminary proposal for improving the use of PTM for EWA decision-making.

Particle Tracking Model

The California Department of Water Resources' particle tracking model simulates the fate of particles moving through Suisun Marsh and the Sacramento/San Joaquin River Delta (Culberson et al., 2004). The model uses velocity, depth and flow output from the one-dimensional hydrodynamic Delta Simulation Model-2 (DSM2) to determine the location of a particle at a given time-step, based upon specified hydrodynamic input variables. The model uses four types of particle movement (transverse velocity, vertical velocity, transverse mixing and vertical mixing) to represent the particles' ability to move through the water. When a particle approaches a junction, a directional choice is made by allocating probabilities to each channel in proportion to flow. The model can track particle movement from any location within the network and at varied velocities, and can be used to simulate settling or swimming. Mortality can be modeled as losses to water diversions or can be assigned as a rate, which can be a function of age or location in the Delta (CDWR, undated).

Applications in 2005

Initial PTM runs. Recent work with PTM in Suisun Marsh indicates that entrainment risk for a particle is strongly influenced by its location relative to a diversion facility

¹ This document has been updated and expanded from a previous version that documented PTM use in water year 2005.

(Culberson et al., 2004). In the Delta, the region of consistently high particle entrainment risk includes the San Joaquin River from Vernalis to about Prisoner's Point and all channels connecting this river reach to Old and Middle Rivers (Kimmerer and Nobriga, unpublished data presented at the 2005 IEP Workshop). The Delta Smelt Working Group (Working Group) used PTM in WY 2005 in conjunction with the Delta Smelt Risk Assessment Matrix (DSRAM; USFWS, 2005) to assist in the formulation of recommendations for modifications of water project operations. Early indicators, such as Spring Kodiak Trawl data and water temperatures, led the Working Group to conclude that most delta smelt spawning would be completed by April 1. Because relatively short spawning periods result in the production of fewer cohorts, larval entrainment losses may impact year-class success in years of short spawning period duration (Bennett, 2005). The Working Group believed that a modification of project operations prior to the beginning of the Vernalis Adaptive Management Program (VAMP) period could provide protection to newly-hatched larvae, and so requested in mid-March that California Department of Water Resources (CDWR) hydrodynamic modeling staff run a series of paired PTM comparisons using injection points based upon Spring Kodiak Trawl data. The Working Group specified, in advance of the simulations, a 30% difference in particle fate as the threshold of significance (Table 1). Review of the initial PTM results did not lead to a recommendation from the Working Group, as the 30% difference-in-fate significance criterion was not met.

Table 1. Summary of the five paired PTM comparisons requested by the Delta Smelt Working Group on March 10, 2005.

| Pre-VAMP Apr. 1-14 | VAMP Apr. 15-May 15 | Post-VAMP May 16-31 |
|---|---|--|
| Baseline vs. Vamp level of exports; particle release points in Cache Slough and Rio Vista | HORB in vs. HORB out; particle release points at Turner Cut and Franks Tract | Baseline vs. Vamp level of exports; particle release points at Turner Cut and Franks Tract |
| | Current CCF gate ops vs. 24-hour CCF gates open | HORB in vs. HORB out |
| Decision points: | | |
| -if <10% difference in proportion of particles in Central Delta, then concern is low -if >30% difference, then concern is high | recommend not installing the HORB if there is a >30% difference in particle entrainment | if the HORB is in, recommend removal on May 15 if there is a >30% difference in particle entrainment |

Updated PTM runs. By the end of March, the beginning of the VAMP period had been delayed until May 1, in the hope that high flows on the San Joaquin River (SJR) tributaries would have stabilized by that time. To incorporate the latest information from

the Spring Kodiak Trawl on delta smelt distribution and projected SJR flows, the Working Group requested additional PTM runs with injection points added in the Central Delta, using the projected VAMP hydrology. The six PTM scenarios run by CDWR staff included:

- San Joaquin River at 7000 cfs with
 - Baseline (full exports)
 - 3000 cfs combined exports beginning 4/16
 - 1500 cfs combined exports beginning 4/16
- San Joaquin River at 10,000 cfs with
 - Baseline (full exports)
 - 5000 cfs combined exports beginning 4/16
 - Baseline exports until 4/30 and 5000 cfs combined exports beginning 5/1

Once again, the Working Group used a 30% difference in particle fate as the threshold of significance. Review of the PTM results (Table 2, Figure 2, a through f) revealed that most of the expected entrainment of particles at the State and Federal export facilities under baseline conditions would occur during the April 16-April 30 period. Particle entrainment from central Delta injection points dropped from >30% to zero at a 5000 cfs level of exports and 10,000 cfs SJR at Vernalis flow and also at a 3000 cfs level of exports and 7000 cfs Vernalis flow. In each case, entrainment was reduced when the combined level of exports was approximately 50% of SJR flow. Because of the high level of concern for delta smelt, the Working Group recommended a reduction in combined exports to 50% of the San Joaquin River flow at Vernalis, to begin as soon as possible and continue until the beginning of the VAMP experiment. This modification of project operations was intended to minimize entrainment of delta smelt larvae and reduce any indirect effects of export pumping on delta smelt prior to the beginning of the VAMP period. The Water Operations Management Team (WOMT) implemented the DSWG's recommendation beginning on April 17. No incidental take was recorded at the export facilities until May 17.

Table 2. Summary of PTM scenarios considered in mid-April by the Delta Smelt Working Group.

| Export Level | SJR = 7,000 | SJR = 10,000 |
|----------------------|--|--------------|
| | Percent of particles entrained by the Projects | |
| Baseline | > 30% | > 30% |
| 1500 cfs combined | 0 | |
| 3000 cfs combined | 0 | |
| 5000 cfs on April 16 | | 0 |
| 5000 cfs on May 1 | | > 30% |

Applications in 2006

Actions for adults. Due to the very low apparent abundance of delta smelt as indicated by the Fall Mid-Water Trawl survey, it was the first priority of the Delta Smelt Working

Group to minimize the entrainment of pre-spawning adults. Analyses completed for the OCAP Biological Assessment indicated that by the time that a salvage event becomes apparent, it would likely already be too late to provide significant protection. The Working Group believed that it would be prudent to implement a protective action in winter as a precautionary measure, and in November began to discuss the most advantageous ways in which to deploy the available environmental water. In addition to analyses generated by the Working Group itself, the Working Group considered analyses produced by the Pelagic Organism Decline Project Work Team (POD PWT). These analyses, which included PTM, suggested that decreases in the Export-to-Inflow (E/I) ratio bringing it below 20% would result in a change in particle fate that could correspond to a decrease in fish salvage (Herbold et al., 2005; Figure 1), leading the Working Group to recommend that a 15% E/I ratio be implemented in early January. However, the action was not implemented due to the arrival of abundant precipitation in late December and early January, which resulted in an E/I ratio of less than 15% without modifications to Project operations.

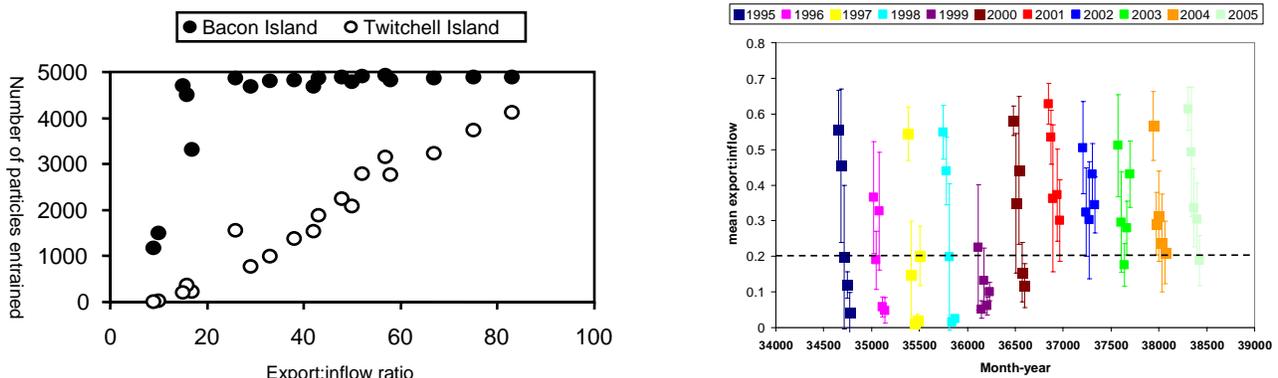


Figure 1. Particle tracking modeling outcomes (left) and monthly average E/I ratios for November through March of water years 1995-2005 (right). From Herbold et al., 2005.

Actions for juveniles. Because concern for delta smelt remained high, the Working Group continued to discuss potential spring actions intended to minimize the entrainment of larvae. Configuration of the South Delta barriers was also of concern. In conjunction with planning for the VAMP, the Working Group requested that DWR modelers run the following PTM scenarios, both with and without the Head-of-Old River Barrier (HORB):

| Exports | SJR Flow |
|----------|----------|
| 1500 cfs | 3000 cfs |
| 1500 cfs | 7000 cfs |
| 7000 cfs | 7000 cfs |

- injection points at 815, 902 and 910 and at SJR at Vernalis,
- 75% exceedence hydrology,
- ag barriers in or out, with HORB,
- open three culverts on the HORB,
- run from April 15 until May 15 (31 days)

As in previous years, the Working Group used a 30% difference in particle fate as the significance criterion. Results of the PTM indicated that the most important factor for entrainment risk was proximity to the export pumps, which was a conclusion also reached in previous studies (Culberson et al., 2004). Effects of barriers were nowhere as great as the effect of overall hydrology. Thus the Working Group recommended that the first priority throughout the spring period would be for strong flows on the San Joaquin River (at least 7000 cfs) and low Project exports (1500 cfs). Not installing the barriers was recommended, but of lower priority than hydrology. After discussion with the VAMP Technical Committee, additional PTM runs were made, to make the runs consistent with VAMP protocols and to model the effects of culvert operations at the HORB. After considering forecast conditions and PTM outcomes, the Working Group made the following prioritized recommendation, in order of highest to lowest preference:

- 7000 cfs SJR/1500 cfs exports/no barrier
- 7000 cfs SJR/1500 cfs exports/barrier
- 5700 cfs SJR/2250 exports/no barrier
- 5700 cfs SJR/2250 exports/barrier (assumed default)

Because inflow to the Delta remained high and salvage of both adults and juveniles remained low, the Working Group did not seek additional PTM runs or modify its recommendations for the remainder of the spring period.

Improving Efficiency

Overall efficiency of the application of PTM to EWA decision-making was fairly good in water years 2005 and 2006. Requests for modeling were fulfilled promptly, enabling timely consideration and formulation of recommendations. However, in their review of the WY 2004 EWA, the EWA Technical Panel remarked on the failure of the EWA implementing agencies to fully utilize existing models in their decision-making process, specifically mentioning the Particle Tracking Model. The Working Group used real-time survey results to provide some of the injection points for the PTM runs requested in WY 2005, but did not, as suggested, use PTM to evaluate sampling locations. This could be a useful exercise that adds valuable context to survey results; however, it seems unlikely that such an evaluation could be done utilizing existing staff expertise.

The Working Group has expressed an interest in PTM runs modeling gate operations at Clifton Court Forebay, to investigate whether modifications of gate operations could help to minimize incidental take at the SWP. In 2006, the Working Group was told that this work was of a lower priority than other work, and as of the date of this report, no PTM runs have been made for CCF gate operations. In the future it may be possible to further develop staff capacity to perform PTM, or it may be appropriate to address this need through future CBDA proposal solicitation processes.

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References used and/or cited

Bennett, W.A. 2005. Critical assessment of the delta smelt population in the San Francisco estuary, California. *San Francisco Estuary and Watershed Science* 3(2): Art. 1, September 2005

California Department of Water Resources (CDWR). Undated. Description of the particle tracking model. http://modeling.water.ca.gov/delta/models/dsm2/ptm/ptm_descript.html

Culberson, S.D., C.B. Harrison, C. Enright and M.L. Nobriga. 2004. Sensitivity of larval fish transport to location, timing, and behavior using a particle tracking model in Suisun Marsh, California. *Amer. Fish. Soc. Symposium* 39:257-267

Delta Smelt Working Group. 2006. Meeting notes.
http://www.fws.gov/sacramento/es/delta_smelt.htm

Delta Smelt Working Group. 2005. Meeting notes.
http://www.fws.gov/sacramento/es/delta_smelt.htm

Herbold, B., C. Armor, R. Baxter, M. Chotkowski, P. Coulston, M. Nobriga and T. Sommer. 2005. Historical patterns in salvage data. Interagency Ecological Program

U. S. Fish and Wildlife Service (USFWS). 2005. Reinitiation of formal and early section 7 endangered species consultation on the coordinated operations of the Central Valley Project and State Water Project and the operational criteria and plan to address potential critical habitat issues. Sacramento, California. 237 pp

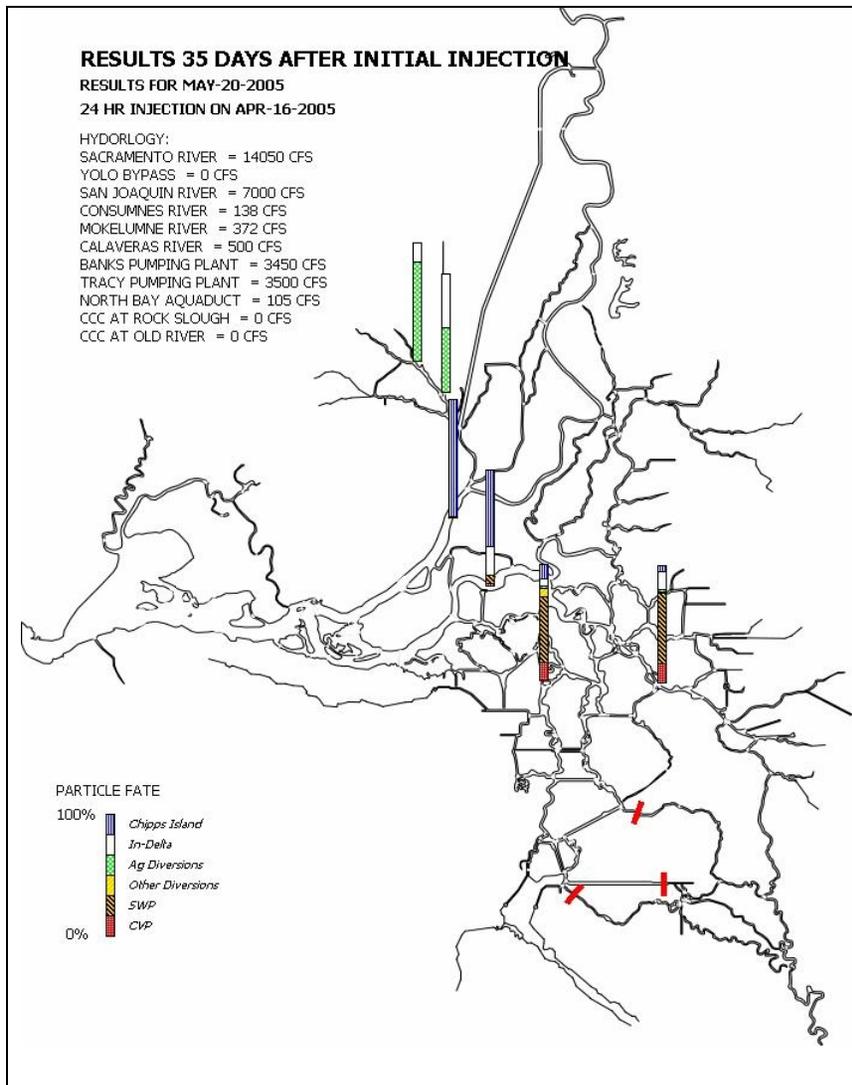


Figure 2.a. Example of PTM output used by the DSWG.

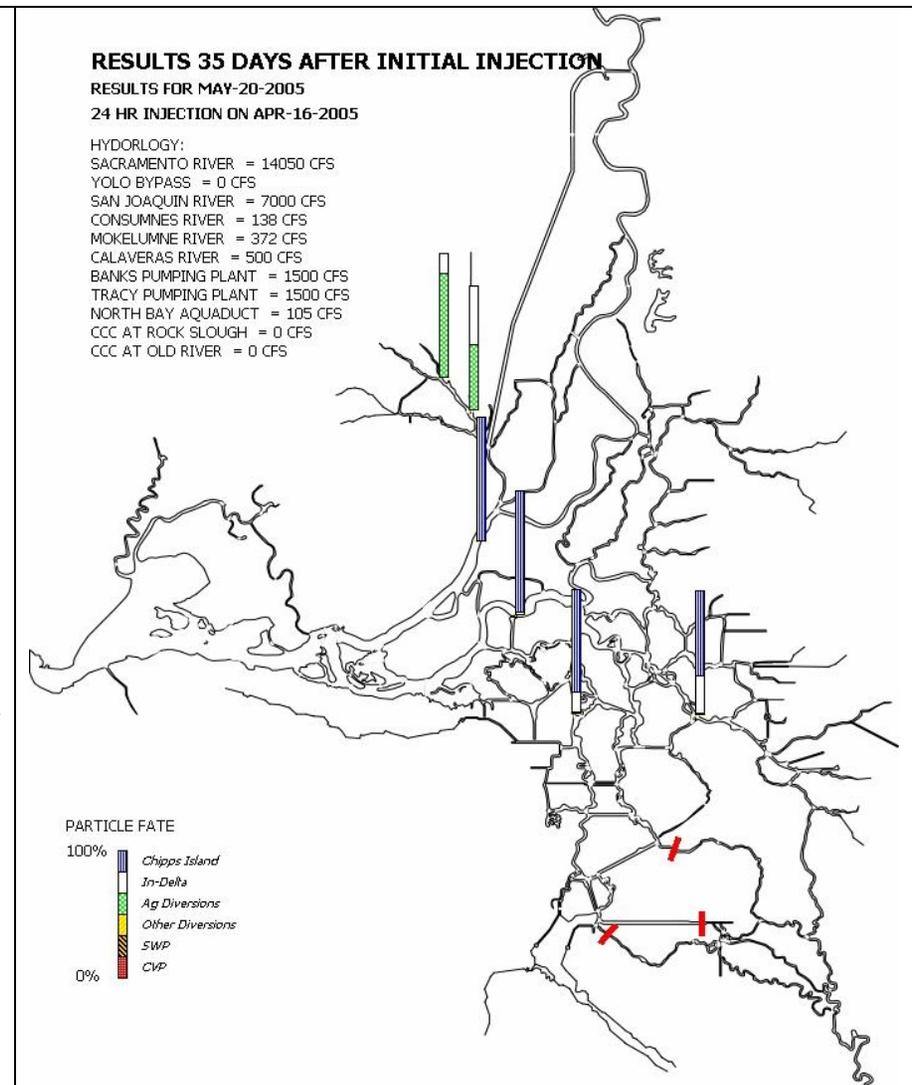
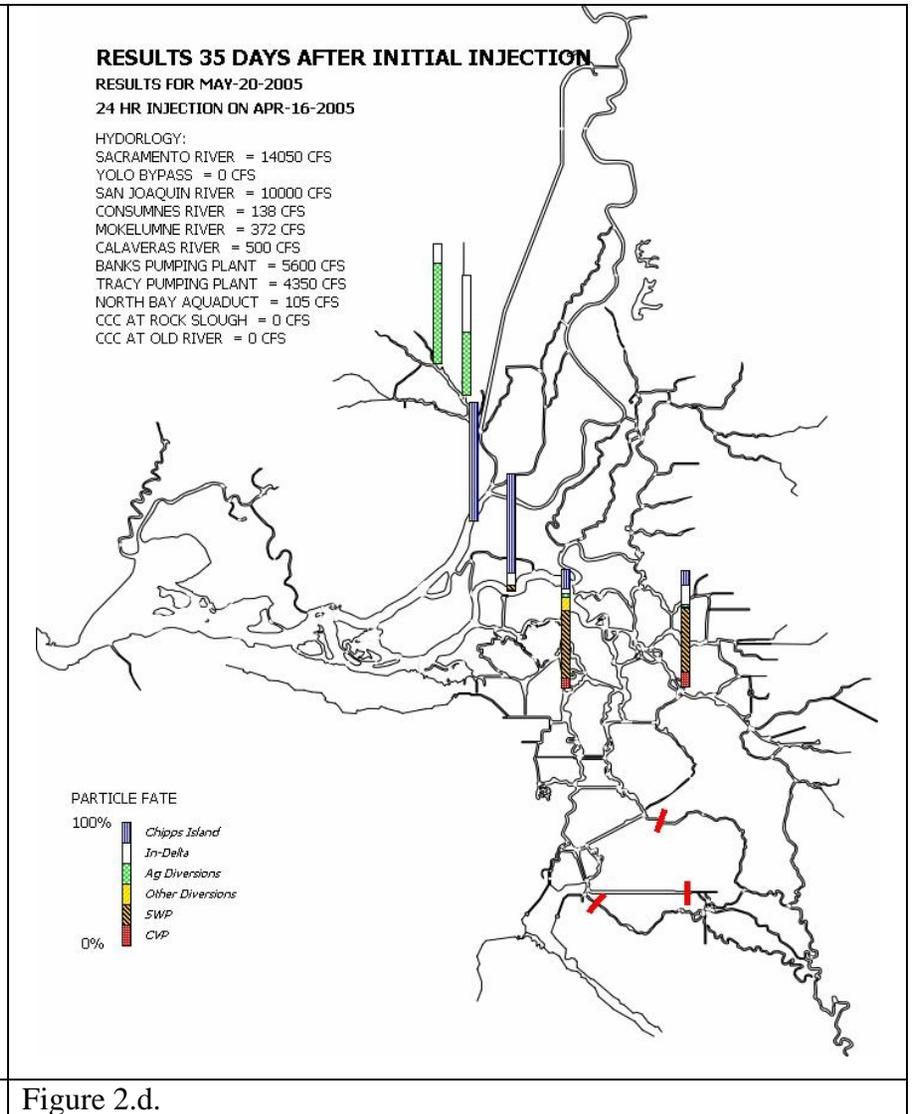
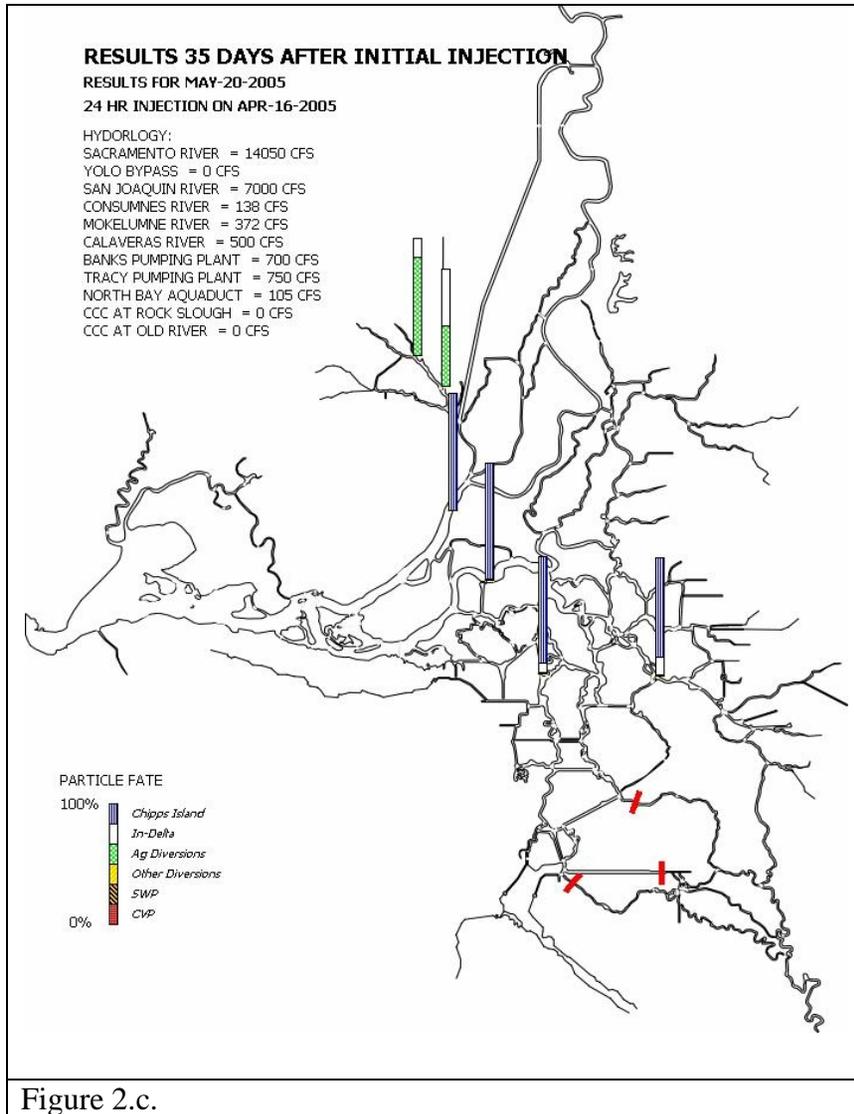


Figure 2.b.



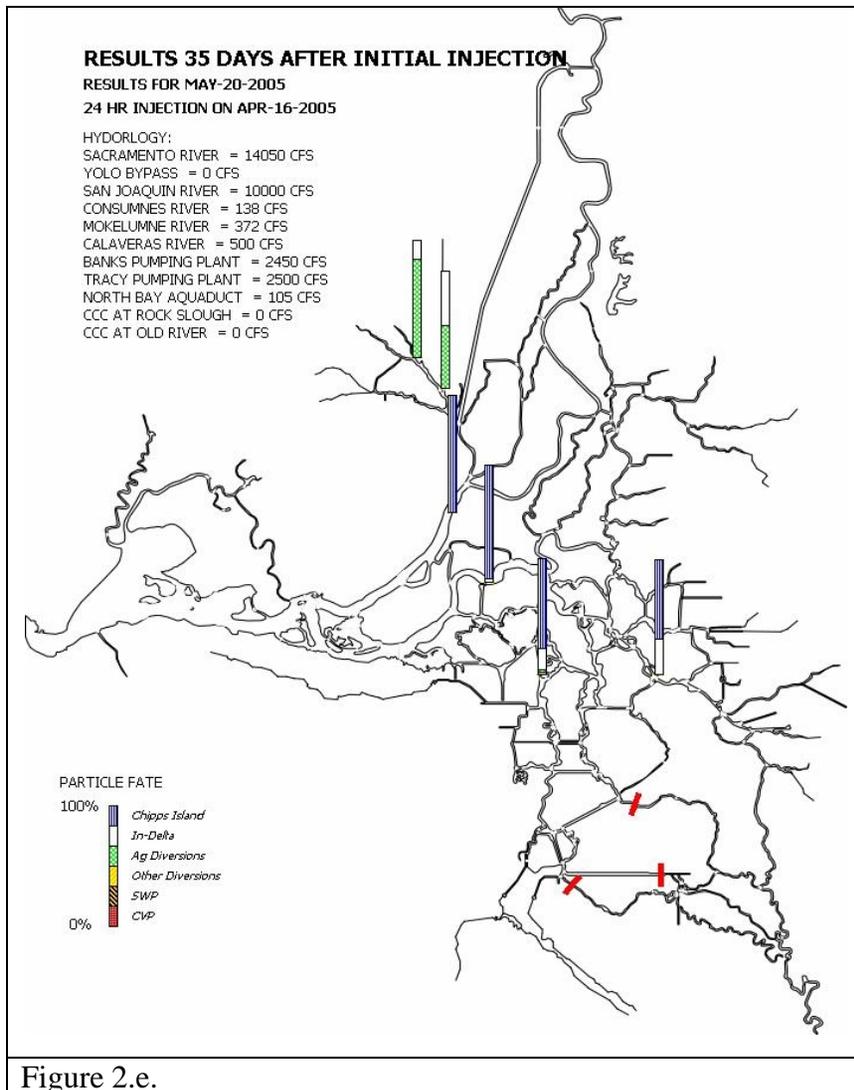


Figure 2.e.

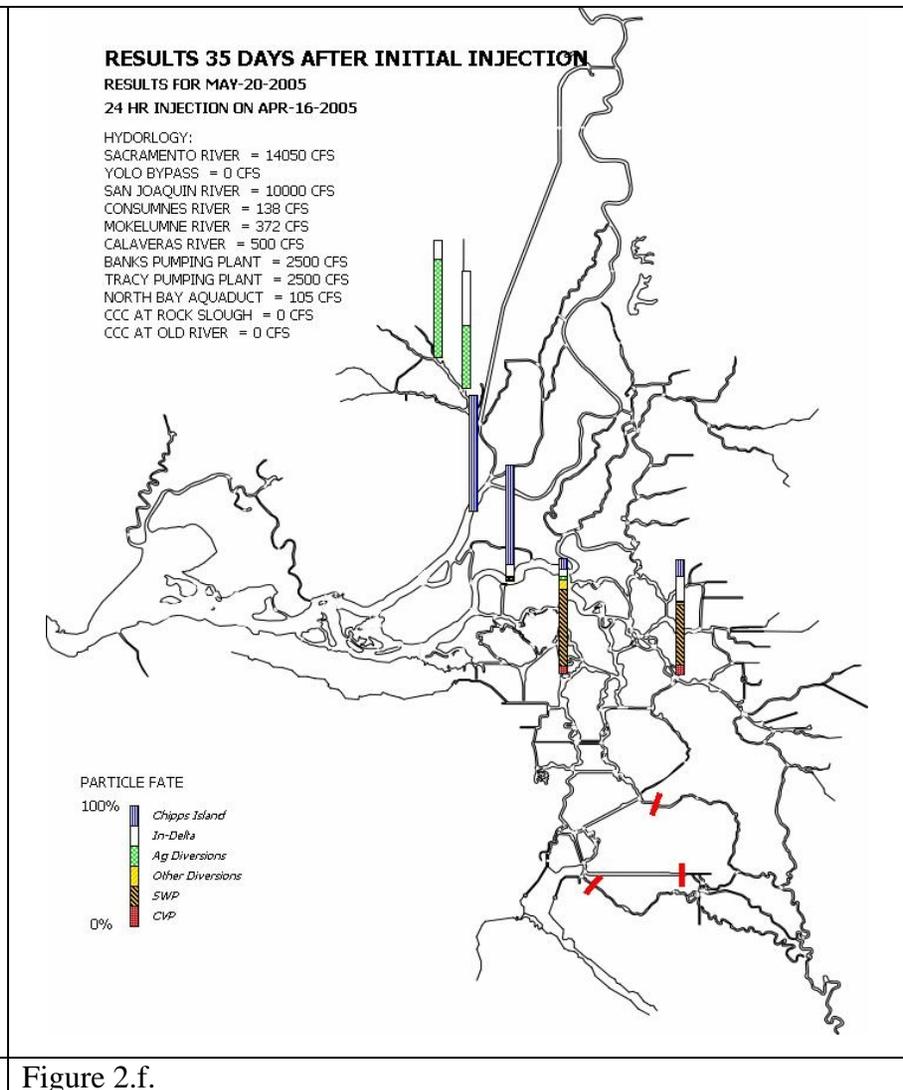


Figure 2.f.

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Appendix 2

EWA related workshops and seminars sponsored by Calfed Science Program in 2005

Randall L. Brown
CALFED Science Program
11/10/05

In 2005 the Science Program sponsored three workshops that bear on the science underlying the EWA. In conjunction with the UCD Center for Aquatic Biology and Aquaculture, the Science Program also initiated a quarterly seminar series. Two of these seminars provide information of interest to agency and stakeholder biologists and Calfed working on the EWA. The following is a brief summary of these activities.

Workshops

Delta Action 8 workshop

Date – May 27, 2005

Purpose and relation to EWA – The DA 8 studies are to evaluate the effects of water project operation on survival of juvenile Sacramento Valley origin Chinook salmon migrating through the Delta. The workshop objective was to provide information relating to the need and design of 2006 and future DA 8 studies.

Product and status – The Science Advisors prepared an interpretive summary report of the report which is posted on the Calfed Science Program. The summary contains recommendations and suggestions by two outside experts. The summary also includes a link to a summary presentation and most of the pertinent study findings. Background data used for the workshop is available at <http://www.delta.dfg.ca.gov/jfmp/patfiles.asp>.

Predation workshop

Dates – June 22 and 23, 2005

Purpose and relation to EWA – This workshop focused on direct losses of juvenile Chinook salmon and steelhead at the intakes to the CVP and SWP with most of the emphasis on the SWP intake at the Clifton Court Forebay. Delta smelt losses were also considered. The losses to predators play a large role in calculating direct losses of juvenile salmonids. The losses in Clifton Court Forebay are based on the results of previous mark-recapture studies. Losses at the CVP intake are not based on actual studies at the intake. Until this workshop we had no field information on juvenile steelhead behavior in the Forebay.

Product and status – The background material – most of the reports dealing with Forebay losses – was assembled and posted on the Science Program website at http://www.science.calwater.ca.gov/workshops/workshop_predation.shtml. The Science Advisors have drafted a workshop summary and are waiting for the report from five

outside experts describing their conclusions. The release date for the summary report and panel reports can not be determined at this time but hopefully by the end of 2005.

Salmonid monitoring workshop

Dates – August 23-25, 2005

Purpose and relation to EWA – This workshop was sponsored by the Calfed Science Program and the USFWS with the objective of addressing Chinook salmon and steelhead monitoring needs in the watershed, the estuary and ocean. The goal was to start a process that will lead to a more coordinated and useful monitoring program. Much of the data collected by the existing program is used in the salmonid decision tree process. The data will also be the basis of evaluating the population benefits of EWA and other protective and restoration actions.

Product and status – The background material posted to the Science Program web site (http://www.calscience.water.ca.gov/workshops/workshop_cvsm.shtml) included two summaries of exiting monitoring efforts – one by NOAA Fisheries dealing specifically with T&E species and the second by DFG providing a more general summary. The Science Program will release and post a written workshop summary which is expected to feed into a comprehensive monitoring plan being developed by the agencies and Calfed. The summary report will be posted to the Science Program website by December 31, 2005.

Seminars

PIT tag seminar – Two USGS biologists came down from the Pacific Northwest to describe their experiences using PIT tags in Columbia River salmon studies. This was in direct response to a suggestion by the former EWA review panel.

POD seminar – This seminar will actually be held on the morning of December 7, 2005 at UCD. Wim and Ted Sommer will be presenting findings from the review of the declines of pelagic organisms in the estuary.

Appendix 3

New Salmon and Steelhead Monitoring Programs

Alice Low
California Department of Fish and Game

In 2005, several new Chinook salmon and steelhead monitoring programs were planned. Funding has been obtained for these programs from the CALFED Ecosystem Restoration Program; program implementation will begin in 2006. The following summaries describe these programs and their relationship to the EWA:

- **Central Valley Constant Fractional Marking Program** – Currently, only experimental releases of fall-run Chinook salmon from Central Valley hatcheries are externally marked and coded-wire tagged, resulting in lack of a consistent, coordinated means of objectively sampling and identifying the stock origin of adults captured in ocean and inland fisheries, and those returning to spawning streams and hatcheries. It is therefore not possible now to monitor the success of actions to restore naturally-spawning populations of fall-run Chinook salmon, including EWA actions; monitor the success of meeting recovery goals; evaluate, minimize and account for the hatchery programs' genetic and ecological effects on natural populations; or evaluate fishery exploitation rates, without knowing the relative contribution of hatchery fish to adult populations.

A comprehensive marking/coded-wire tagging program for production releases of fall-run Chinook salmon from Central Valley hatcheries has been under development since 1998. In 2005, a detailed proposal and budget were developed for the program, and funding was obtained from the CALFED Ecosystem Restoration Program. Automated marking/tagging equipment will be purchased in 2006; production marking/tagging will begin in the spring of 2007.

- **Central Valley Chinook Salmon Escapement and Steelhead Monitoring Plans** – Existing adult Chinook salmon escapement monitoring programs in the Central Valley are currently inadequate to estimate population status and evaluate population trends in a statistically valid manner for several management purposes: providing a sound basis for assessing recovery of listed stocks, monitoring the success of restoration programs, evaluating the contribution of hatchery fish to Central Valley populations, and sustainably managing ocean and inland harvest. Very few monitoring programs collect data on Central Valley steelhead populations.

Over the past year, proposals were developed for long-term monitoring plans to estimate population status and trends in abundance of adult Central Valley Chinook salmon and steelhead in a statistically valid manner. Funding has been obtained from the CALFED Ecosystem Restoration Program; implementation will begin in 2006.

In development of the plans, existing Chinook escapement programs will be reviewed for adequacy of statistical power or bias. Sampling designs will be reviewed and recommendations made for improvement of existing programs. Comprehensive

databases and reporting will be developed linking escapement, hatchery production, and coded-wire tag data. For steelhead, a statistically-valid monitoring strategy will be developed, along with comprehensive databases and reporting systems.

These plans will result in improvements to the Chinook salmon and steelhead monitoring system that will, in turn, lead to improved real-time management of EWA assets for fishery protection.

- **Central Valley Chinook Salmon Age Determination Program** – Currently, the age of salmon returning to spawn in Central Valley streams is not determined on a consistent basis, even for the listed stocks of winter and spring-run Chinook salmon. This lack of aging data precludes accurate reconstruction of the size of each brood year at various points in the life cycle, and thus precludes accurate life cycle modeling needed to evaluate programs such as the EWA. It is not possible to monitor the success of restoration actions in restoring naturally-spawning populations of Chinook salmon, or monitor the success of meeting recovery goals, without determining the age structure of returning adults and the relative contribution of hatchery fish to adult populations. When age data are available, cohort reconstructions of each brood can provide population parameters such as total ocean abundance, ocean harvest rates, maturation rates, stray rates and the relationship between younger ages in-river to predict older ages remaining in the ocean.

Over the past year, a proposal was developed for a comprehensive Central Valley Chinook Salmon Age Determination Program. Funding was obtained from the CALFED Ecosystem Restoration Program; implementation began in the summer of 2006.

Appendix 4

2006 CALFED Science Fellows

Pre-docs

Perry, Russell

Title: Estimating route-specific survival and distribution of juvenile salmonids migrating through the Sacramento -San Joaquin river delta

Research Mentor: Skalski

Community Mentor: Bureau

Clemento, Anthony

Title: Validation of a new method for population assessment of pacific salmonids using genetic markers

Research Mentor: Garza

Post-docs

Sullivan, Lindsay

Title: Prey selection of larval and juvenile planktivorous fish in the San Francisco Estuary

Research Mentor: Kimmerer

Community Mentor: Sommer

Whitcraft, Christine

Title: Role of exotics as ecosystem engineers affecting estuarine food webs in suisun marsh

Research Mentor: Talley

Community Mentor: Wallace

Woodley, Christa

Title: The impacts of global climate change on delta fishes: predicting fish abundance, distribution and community changes

Research Mentor: Moyle

Community Mentor: Cech

Parker, Alexander

Title: Heterotrophic bacteria and the foodweb of the low salinity zone and salt marsh habitats of the San Francisco estuary

Research Mentor: Dugdale

Community Mentor: Mueller-Solger

Luengen, Allison

Title: Mercury interactions with algae: effects on mercury bioavailability in the San Francisco bay delta

Research Mentor: Hernes

Community Mentor: Bergamaschi

Seavy, Nathaniel

Title: Measuring and predicting the success of riparian restoration for wildlife populations: accommodating uncertainty and complexity

Research Mentor: Quinn

Community Mentor: Howell

Sardella, Brian*

Title: Temperature and salinity effect on the physiology of white sturgeon

Research Mentor: Kultz

Community Mentor: Gingras

Schroeter, Robert *

Title: Temporal and spatial patterns in abundance and production of pelagic organisms in the low salinity zone (Suisun Marsh, Bay and Delta) of the San Francisco Estuary with insight into trophic position and impacts of alien invasive species.

Research Mentor: Moyle

Community Mentor: Mueller-Solger

Appendix 5

Charge to Science Advisors (Revised February 2005)

Primary role:

The advisors report directly to CALFED Lead Scientist and provide advice on issues relating to water management and fish protection and restoration in the Central Valley and San Francisco Estuary, with special emphasis on the Environmental Water Account.

Activities and Responsibilities:

Although the activities of the science advisors are expected to vary each year based on changing priorities and events, many of their activities can be categorized as follows:

1. Keep abreast of EWA operations and fish protection actions

The advisors will keep track of current activities of the Data Assessment Team and Water Operations Management Team, specifically with regard to use of EWA assets for fish protection. The advisors will follow these activities through a combination of attending meetings of the EWA Science Team, monitoring DAT calls and meeting summaries as appropriate and attending WOMT meetings as requested by the Lead Scientist. The advisors will inform the Lead Scientist and Science Program Manager of technical issues that may require their attention. As appropriate the advisors may recommend specific actions to be taken by the Lead Scientist.

2. Work with the Lead Scientist, Science Program staff and agency representatives to organize and participate in periodic reviews of the EWA

Annual reviews of the EWA were an integral part of initial four-year EWA experimental implementation and periodic reviews should be part of the interim (years 5-7) and long-term EWA. The advisors will assist the Lead Scientist in establishing review panels, establishing time frames and agendas for the reviews, preparing and submitting written technical materials, making oral presentations, and drafting responses to EWA panel comments and recommendations.

3. Provide technical assistance to the Lead Scientist in identifying and filling key information gaps.

The CALFED Lead Scientist has overall responsibility for CALFED Science, but may require technical assistance for complex issues such as those involved with EWA and with protection of listed fish species. Information gaps may prevent CALFED from obtaining the maximum benefit from its assets, or may not result in the best combination of actions. To assist the Lead Scientist in this capacity, the advisors will identify science issues that should be addressed through new analyses, workshops, symposia, or additional studies. As directed by the Lead Scientist, the advisors will help organize workshops and symposia, conduct additional technical analyses, and prepare papers for technical review and, if appropriate, publication. These efforts will require that the advisors work closely with Science Program staff, agency representatives, stakeholders and academic scientists. In addition, the advisors will continue to organize (or

participate in organization of) annual workshops on important issues related to the effects of water project operations, particularly EWA, on salmon and delta smelt.

4. Provide technical review

As requested by the Lead Scientist, the advisors will review, or solicit reviewers for, technical documents in the fields of water management, fish ecology, and ecosystem processes. Performance measures being developed by the Science Program and others are expected to be included as a topic for review.

5. Annual workplan

By October 1 of each year the advisors will submit a draft plan outlining their proposed activities for the upcoming year. The plan will be shared with the EWA Science working group before becoming final. The Lead Scientist and the advisors recognize that the plan must be flexible, and that events may preclude all activities being completed on schedule. The advisors will provide progress reports, and the plan will be adjusted if necessary.

6. Reporting requirements.

The advisors shall report frequently to the Lead Scientist or his designee. Most of these reports will be sent by email, but face-to-face meetings or conference calls will be held as needed and schedules permit. At least one of the advisors is expected to attend meetings of the informal EWA Science working group. As requested by the Lead Scientist, the advisors may attend meetings of WOMT, the Agency Coordination Team, the Authority, or BDPAC to present technical information related to water operations and fish and their ecosystems.